A Concept for Terminal Weather Translation and Advisory

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Agenda

▪ What is the Problem?
▪ ATM-Weather Integration Framework
▪ Description of the Concept
▪ Application to Atlanta Airport
▪ Results of Evaluations
▪ Conclusions

What’s the Problem?

Meteorologist's Briefings

Terminal Weather Forecasts (4x/day)

Source: NWS AWC [6]

Terminal Weather Observations (hourly, variable)

Source: NWS AWC [6]

Weather Radar

Source: MIT Lincoln Lab CIWS display [4]

Approach Type?

Visual

Instrument

Low Instrument

Approach Rate?

Capacity Estimates

Airport Arrival and Departure Rates

Traffic Manager/ Front Line Manager

Traffic Demand

Source: FAA [7]

Source: FAA.gov [5], augmented by MITRE
Addressing the Problem with the ATM-Weather Integration Framework

Raw weather direct to FAA and User DSTs (E.g., winds and temps for trajectory calculations)

Not Integrated
- Displayed independently
- Cognitive interpretation
- Manual use & application

Minimally Integrated
- Displayed on the glass
- Cognitive interpretation
- Manual use & application
- Trajectory generation

Weather Translation
- NAS Constraints
- Threshold Events

Non wx factors

ATM Impact Conversion
- NAS Impacts
- State Changes

Non wx factors

Impact Resolution
- Tactical TFM Solutions
- Strategic TFM Solutions
- Optimization

Terminal Weather Translation & Advisory

Level 0
Level 1
Level 2
Level 3
Level 4

Source: MITRE
Terminal Weather Translation and Advisory Concept

Observations/Forecasts
- Ceilings
- Visibilities
- Winds

Surface/Terminal Decision Support*

Terminal Weather Translation

* e.g., Terminal Flight Data Manager, Arrival Manager, Departure Manager, etc.

- Current or forecast changes in cloud heights, visibility, wind speed and direction that cross or are expected to cross site-adapted threshold values, are translated to weather threshold events

- Weather threshold events are converted to airport operational state changes and advisories that support decision support displays
Application of Concept to Atlanta

Visual Approaches (VIV): Pilot sees aircraft ahead on other approaches or airport
- Cloud Base < ~ 6000 MSL: Visual / Instrument / Visual (VIV)
- Cloud Base < ~ 5000 MSL: I | V
- Cloud Base < ~ 4000 MSL: I | I (triple Instrument approaches)
- Cloud Base below 1000 AGL and visibility 3 mi or less
- Cloud Base below 800 AGL and visibility 2 mi or less
- Cloud Base below 400 AGL (radar sep 3 nm)
- Cloud Base below 200 AGL and visibility 1/2 mi or less (Cat II/III)
Translation Concept for 2\textsuperscript{nd} Evaluation
Evaluations (1 of 2)

- Two Table top evaluations held November 2016 and April 2017
- Terminal weather translation concept applied to Atlanta airport/terminal for Evaluation
- Three scenarios covering multiple weather conditions
- Evaluators were MITRE subject matter experts
  - former controllers and Traffic managers Tower and TRACON experience including Atlanta TRACON
Evaluation 1: Understand how TWT would be used operationally

- What weather information content is needed and when is it most useful?
- Does the concept augment or replace current weather information, and if so, how?
- Does the concept add value to current decision-making processes/outcomes?
- What concept deficiencies were experienced - how could be improved?

Evaluation 2: Do users find the TWT concept useful and operationally acceptable?

- Does TWT information augment and/or replace current weather information, and if so, how?
- How does TWT information add value to or influence current decision-making processes/outcomes?
- Were concept deficiencies experienced during the evaluation, and if so, how could they be improved?
- Does information provided by TWT improve user situation awareness?
- Does TWT enable uniformity in weather-based decision-making?
- Can TTE 2 results be used to evolve the concept?
Concept Evaluation – Scenarios

1st Eval

Scenario 1: Feb 2, 2016
- Wind changes
- Time period: 16Z-19Z
- VMC throughout
- No precipitation

Scenario 2: Feb 1, 2016
- Cloud height and visibility
- Time period: 12Z-18Z
- Worsening then improving conditions
- Winds relatively light, stable direction. No wind shift or speed issues

Scenario 3: Sep 11, 2015
- Cloud height and visibility - Low
- Both worsening and improving conditions
- No wind shift or wind speed issues

2nd Eval

Scenario 1: Mar 2, 2017
- Wind changes
- Varying ceiling conditions

Scenario 2: Mar 26, 2017
- Varying ceiling and wind direction changes associated with convective weather

Scenario 3: Apr 3, 2017
- Varying ceiling and wind direction changes associated with convective weather
Scenario Weather Day – Feb 1 2016

Source: CIWS – MIT Lincoln Laboratory
1st Evaluation Results (1 of 2)

S1. Translated Weather Replaces the Need to Gather Weather Information from Multiple Sources

- **Strongly agree**: 9
- **Agree**: 7
- **Neutral**: 0
- **Disagree**: 0
- **Strongly disagree**: 0

S2. Translated Weather Replaces the Need to Mentally Integrate Information

- **Strongly agree**: 8
- **Agree**: 8
- **Neutral**: 1
- **Disagree**: 0
- **Strongly disagree**: 0

Source: MITRE
1st Evaluation Results (2 of 2)

S3. Translated weather for local airports arranged in a Situation Display provides Useful Information

- Strongly agree: 10
- Agree: 3
- Neutral: 2
- Disagree: 2
- Strongly disagree: 0

Source: MITRE

S5. Translated weather arranged in Decision Support format provides Actionable Information

- Strongly agree: 12
- Agree: 5
- Neutral: 0
- Disagree: 0
- Strongly disagree: 0

Source: MITRE
2nd Evaluation Results (1 of 2)

S4. The TWT concept look-ahead of 2 hours will support decision-making on terminal operations

- Strongly agree: 8
- Agree: 2
- Neutral: 0
- Disagree: 0
- Strongly disagree: 0

S7. A translated weather will reduce the need to access weather information from other sources

- Strongly agree: 5
- Agree: 5
- Neutral: 0
- Disagree: 0
- Strongly disagree: 0

Source: MITRE
## 2nd Evaluation Results (2 of 2)

**S8. The concept will reduce the need for mentally integrating and translating weather information**

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Source: MITRE

**S9. Common display of translated information in ATCT and TRACON will support efficient coordination for decision-making**

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Source: MITRE
Conclusions

- Decision-makers will likely prefer translated weather information over text weather observations (METARs) and forecasts (TAFs)
- Terminal weather translation will likely provide information that is useful and actionable
- Terminal weather translation will likely replace the need to gather weather information from multiple sources
- Terminal weather translation will likely reduce the need for operational user to cognitively integrate and translate weather information
- Recommend decision-makers at area control centers have access to terminal weather translated for airports in their area of responsibility
- Recommend decision-makers at the command centers or central flow control have access to terminal weather translated for airports
- Terminal weather translation will likely not replace the need for input and guidance from human meteorologists
References


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